THE DISTRIBUTION OF FOREST TREES IN NORTHERN BAJA CALIFORNIA, MEXICO

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ABSTRACT

This survey includes maps and provides descriptions of the distribution of 22 Pacific Coast temperate trees, including two endemics, in northern Baja California, from the international border south to latitude 30°. Ranges were discerned from aerial photographs and verified by field reconnaissance, botanical collections, and a low-altitude aerial flight. With the exception of mixed conifer and pinyon forests, most forests comprise single tree species that represent fragments of more diverse ecosystems from more mesic areas of California. The rapid decline in the diversity of Pacific Coast temperate trees below the international border reflects strong precipitation gradients associated with orography. Several California tree species have been reported erroneously in northern Baja California due to the misidentification of specimens, or the misinterpretation of common plant names or place names.

The southern geographic limits of many Pacific Coast temperate trees are in the mountains and coastal valleys of northern Baja California, Mexico. From various sources, Griffin and Critchfield (1976) mapped the ranges of these trees for California, but detailed maps stop at the international border. This survey includes detailed maps and provides descriptions of the natural distribution of 22 trees, including two endemics, in northern Baja California, from the international border south to latitude 30° (Fig. 1).

METHODS

Many localities are derived from botanical collections and field observations. Extensive collections, particularly by Wiggins (1980, DS), and Moran (SD) have probably recorded most of the flora of northern Baja California. I also consulted other botanical collections from SD, RSA, UCLA, and UCR. On each map I have plotted each collection that had definite locality data. Point records, however, are difficult to extrapolate into broader geographic distributions, because collections are invariably non-random and reflect particular interests and access. Indeed, many remote areas have never been visited.

Important locality data come from the extensive library of aerial photography at the Department of Earth Sciences, University of California, Riverside (Table 1). These photographs show the forests of northern Baja California, which are conspicuous in this semiarid shrubland landscape. I studied photographs on a Bausch and Lomb

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TABLE 1. AERIAL PHOTOGRAPHS OF NORTHERN BAJA CALIFORNIA. [1] = México 12, D.F.; [2] = INEGI (Institute Naciónal de Estadistica, Geografica y Informatica), Mexico, D.F.

Source	Film	Year	Season	Scale	Resolution	Comments
Mexicana Aerofoto[1]	Black & White	1938	summer	1:20,000	good	lat. 31°45′ to U.S. border
Mexicana Aerofoto[2]	Black & White	1956	fall	1:40,000	good	comprehensive coverage south to lat. 30°
Mexico, INEGI[2]	Black & White	1972	summer	1:50,000	excellent	comprehensive coverage

TABLE 2. AERIAL PHOTO CHARACTERISTICS OF TREES. Table data from Heller, Doverspike, and Aldrich (1964); map data for *Fraxinus velutina* var. *coriacea, Populus trichocarpa, Quercus englemannii,* and *Q. wislizenii* based exclusively upon botanical collections. [1] = Data only for species with diagnostic hues; other trees have nondistinct intermediate grey tones.

Species	Hue[1]	Adult height (m)	Height: Crown spread	Distance crown base to ground (m)	Crown apex	Crown margins	Foliage	Comments
Abies concolor		20–30	4–8	<5	acute to narrowly rounded	serrate	dense	
Calocedrus decurrens	light	20–35	3–6	5–10	acute to narrowly rounded, broad base	entire to serrate	drooping	
Cupressus arizonica var. *stephensonii*	light	2–10	1–3	0	acute	irregular	dense	
C. forbesii		4–7	1–2	0	obtuse	adults irregular, ascending branches	juveniles spoked, dense	even-aged stands
C. montana		10–15	1–2	<5	obtuse	serrate	thin	
Pinus attenuata		5–10	1–2	0	broadly rounded, straggling	irregular	frayed/thin	even-aged stands
P. contorta		15–25	5–10	<5	acute to narrowly rounded	entire to serrate	thin	straight boles in shadows
P. coulteri		10–20	1–4	0–5	broadly rounded to obtuse	deeply serrate	moderately dense	branches rise at terminus

TABLE 2. CONTINUED.

Species	Hue[1]	Adult height (m)	Height / Crown spread	Distance crown base to ground (m)	Crown apex	Crown margins	Foliage	Comments
P. jeffreyi		20–40	3–6	5–15	broadly rounded to flat	deeply serrate	moderately dense, columnar branches	
P. lambertiana		20–40	2–5	5–10	broadly rounded to flat	lobed	wheel spokes, stellate	branches pendulous
P. monophylla		10–15	1–2	0	broadly rounded to flat	sinuate ragged	frayed	
P. muricata		5–15	1–2	0	broadly rounded	irregular	dense	even-aged stands
P. quadrifolia		10–15	1–2	0	rounded to conical	entire to slightly sinuate	moderately dense	
Platanus racemosa–Populus fremontii	dark	20–35	2–5	5–10	obtuse to acute	lobed sinuate	dense, limbs show	winter deciduous, gallery forest arrangement
P. tremuloides	light	5–20	3–6	<5	acute	entire to finely serrate	—	dense clone stand structure, winter deciduous
Quercus agrifolia	dark	10–25	1–2	3–5	flat	coarsely sinuate	dense	usually 2 or 3 primary spreading branches
Q. chrysolepis	dark	5–10, 20	0.5–1, 3	0	spherical	entire	compact	
Q. peninsularis	light	3–6, 15	0.5–2	0–5	flat	entire, slightly sinuate	moderately dense	partly winter deciduous, branches horizontal

roll film stereoscope with 3 and 8× magnification. Tree species were recognized from gross characters that included crown perimeter and shape, vertical structure, shadows, and color (hue) (Table 2).

Interpretation was verified by field reconnaissance and botanical collections. The process of developing diagnostic identification of trees required progressive cross-referencing between aerial photography and ground observations. Field data that were plotted on work maps or recorded on ground photographs also were correlated with aerial photographic signatures in the laboratory, and photographic information was verified in the field. I traveled through many forested areas of the Sierra Juárez, Sierra San Pedro Mártir, and several coastal sites (Minnich 1986). I flew one low-altitude reconnaissance (within 600 m of ground) in May 1986 from Tijuana to Cerro Bola, Valle Guadalupe, Cerro Los Pinos, Sierra San Pedro Mártir, Sierra Juárez, Valle las Palmas, and back to Tijuana.

Tree ranges were transferred from photographs onto 1:250,000 topographic quadrangles using a Bausch and Lomb Zoom Transfer Scope. The ranges shown on Figs. 2–16 will be modified by subsequent field research because the scale of aerial photography results in omissions, particularly local outposts and among species forming scattered small stands. Subtropical trees such as *Washington filifera* Lindl., *Erythea armata* Wats., and *Prosopis juliflora* (SW.) DC. are excluded from this treatment.

Physical Setting

Physiography. The coastal valleys and mountains of northern Baja California extend into the southern part of the Mediterranean climatic zone along the Pacific Coast. Although the region is at the southern margin of reliable winter cyclonic storms, seasonally moist habitats are widespread because the large relief of mountainous terrain provides cooler temperatures with altitude and encourages orographic precipitation.

The physiography of the region can be subdivided into three ranges of the peninsular range province (Fig. 1) (Gastil et al. 1975). The Sierra Juárez, an extension of the Laguna Mountains of southern California, is an undissected plateau (elev. 1200–1800 m) of mostly granite substrate from the international border southeastward to near Santa Catarina. The southern third of the Sierra Juárez, south of Santa Catarina, is an extensive tableland of mesas capped by Miocene volcanics, with summits to nearly 2000 m.

Toward the Pacific coast, there is a discontinuous series of dissected, lower ranges (1000–1400 m), termed here the coastal Sierra Juárez, that extends southeastward from an unnamed range southwest of Valle las Palmas (Cerro Bola, 1280 m) to Ensenada Bay. Substrates include a granitic batholith, and extensive prebatholithic

(Cretaceous) undifferentiated volcanics, metavolcanics, and marine sediments (Alistos formation). The coastal and interior Sierra Juárez are separated by alluvial basins and low plateaus, including Valle las Palmas, Valle Guadalupe, Valle Ojos Negros, and an extensive high basin between Santa Catarina and El Alamo. South of Ensenada Bay, the coastal Sierra Juárez increases in altitude (1200–1500 m) and turns eastward along the Agua Blanca fault.

South of Valle la Trinidad, these transverse coastal ranges join the Sierra San Pedro Mártir batholith, characterized by a steep western scarp (vertical relief 700–1000 m) and extensive plateaus along the crest, the elevations of which decrease in steps from 2500 m in the north to 1800 m at Cerro Matomí. The area from the west scarp to the ocean contains extensive low foothills and mesas. These include a series of low northwest-southeast trending coastal ranges from Valle Santo Tomás to Colonet. The substrate is derived mostly from the Alistos formation, with Cretaceous marine sedimentary rocks (Rosario formation) outcropping along the coast. The faulted eastern scarps of the Sierra Juárez and Sierra San Pedro Mártir are rugged with numerous small canyons.

Climate. Annual precipitation results mostly from frontal storms that occur between December and March. It ranges from 200–300 mm in the coastal valleys to 500 mm in the mountains, and only 100 mm on lee slopes at the margin of the Sonoran Desert (Table 3). Heaviest precipitation occurs on the highest peaks of the coastal ranges, and on the western slopes of both the interior central Sierra Juárez and Sierra San Pedro Mártir. Despite their altitude, the southern Sierra Juárez tablelands are arid due to rainshadows created by the relatively high coastal peaks south of Ensenada. Because high relief becomes discontinuous along the peninsula south of the Sierra San Pedro Mártir, the rainfall, which is dependent primarily upon orography, becomes unreliable south of lat. 30°, where the Sonoran Desert extends west to the Pacific Coast.

Winters are mild from the coast inland to the interior valleys (Table 3). Ground inversions, however, produce cold nights and hard frosts in high mountain plateaus. Snowfall may account for no more than ca. 15% of the annual precipitation in the Sierra Juárez, but perhaps as much as 50% in the higher Sierra San Pedro Mártir (Minnich 1986a).

During summer, near-coastal valleys and western slopes of the coastal Sierra Juárez are cool, humid, and foggy because of the onshore flow of marine air with sea breezes and valley wind systems, as in California. Interior mountains and valleys are warm and dry except for occasional afternoon thundershowers that mostly occur along the eastern walls of the Sierra Juárez and Sierra San Pedro Mártir and are caused by surges of tropical moisture that move north along the Gulf of California from the subtropical Pacific Ocean.

TABLE 3. CLIMATOLOGICAL DATA FOR NORTHERN BAJA CALIFORNIA. (Mexico, no date). Data at stations with short records are normalized for long-term mean normals (1949–84), by 1° latitude bands at the following stations: lat. 32°, Presa Rodriguez, Valle Las Palmas, El Pinal; lat. 31°, Ensenada, Ojos Negros, Santo Tomás, San Vicente, El Alamo; lat. 30°, San Telmo, Las Escobas, El Rosario. [1] = Estimate.

Station	Elev. m	Latitude/longitude (degrees & minutes) °N	′	°W	′	Period of record	Temperature Jan °C	Temperature Jul °C	Annual precip. cm
Near coast									
Planta Rosarito	22	32	18	117	02	1970–	13	20	24
Ensenada	24	31	52	116	38	1949–	13	20	26
San Telmo	70	30	58	116	05	1949–	11	21	20
Las Escobas	50	30	35	115	56	1949–	11	20	15
Coastal ranges & valleys									
Olivaros Mexicanos	351	32	03	116	37	1954–	12	23	32
San Carlos	170	31	47	116	27	1962–	13	21	30
San Vicente	110	31	20	116	14	1949–	12	22	22
El Rosario	82	30	04	115	43	1949–	14	22	15
Inland valleys									
Valle Las Palmas	280	32	22	116	37	1949–	12	25	20
Ojos Negros	712	31	55	116	16	1949–	12	25	24
Valle Trinidad	780	31	21	115	41	1968–	9	25	22
Rancho Santa Cruz	970	30	53	115	38	1959–	12	25	32
Mountains									
El Pinal	1350	32	11	116	18	1949–	8	22	44
San Juan de Dios	1275	32	07	116	10	1956–	7	22	41
Sierra Juárez	1580	32	00	115	57	1961–	5	19	36
Santa Catarina	1150	31	29	115	49	1958–	9	24	21
Parque Naciónal San Pedro Mártir	2080	30	58	115	35	1981–	3	17	45[1]

Species Distributions

The geographic distributions of northern Baja California trees reflect a number of factors, including altitudinal zonation, topography, substrate, and climatic gradients associated with orography, distance from the Pacific Coast, and latitude. With the exception of mixed conifer forests (*Pinus jeffreyi, P. lambertiana, Abies concolor, Calocedrus decurrens*) in the Sierra San Pedro Mártir and xeric pinyons (*Pinus quadrifolia, P. monophylla*), most forests include single tree species with highly localized distributions that represent fragments of more diverse ecosystems in more mesic areas of California.

Abies concolor (Gord. & Glend.) Lindl. (Fig. 2). White fir is common above 2200 m in the mixed conifer forest that covers the Sierra San Pedro Mártir. Individuals have been found as low as 1900 m along Arroyo los Pinos near Corral de Sam (Table 4). Although *Pinus jeffreyi* is the dominant tree of most forests in the range, *A. concolor* is locally dominant with *P. lambertiana* on steep northern exposures in the vicinity of Cerro Venado Blanco, Cerro la Botella Azul, and upper headwalls of the eastern escarpment, including Picacho del Diablo; a photo by Clyde (1975:85) records a sapling at the summit (3095 m). I have not seen *A. concolor* in extensive forests of *P. jeffreyi* south of La Grulla and La Encantada meadows. This tree has short, thick, wide leaves of the southern California-Rocky Mountain variety (Vasek 1985). The nearest stand is 180 km north in the Cuyamaca Mountains of San Diego Co., California (Griffin and Critchfield 1976), and, thus, is not known from the Sierra Juárez.

Calocedrus decurrens (Torr.) Florin (Fig. 3). Incense cedar is rare even in the highest mountains of northern Baja California. In the Sierra San Pedro Mártir it grows mostly near streams from 1350–2400 m on the northern and eastern scarps of the plateau. It also has been collected along several arroyos to the south, as at La Corona, Valladares Creek, La Víbora, and La Encantada. The southernmost locality I have seen is along a gully 5 km south of La Grulla. Beyond stream habitats, incense cedar is occasional in mixed conifer forests at Vallecitos, including the largest tree of any species I have seen in the range (3 m dbh, 45 m height).

Moran found few *C. decurrens* groves in moist habitats within *Pinus jeffreyi* forest in the central Sierra Juárez, including La Matanza meadow, and Arroyo El Tule. Aerial photographs confirm his observation that the tree is relatively abundant along the canyon at El Tule. Federal foresters in Baja California have seen the tree along the arroyo that drains Laguna Juárez.

Cupressus arizonica Greene var. stephensonii (C. B. Wolf) Beauchamp (Fig. 4). This variety of Arizona cypress was believed to be endemic to the Cuyamaca Mountains in San Diego Co. (Griffin and Critchfield 1976) until another larger cluster of populations was

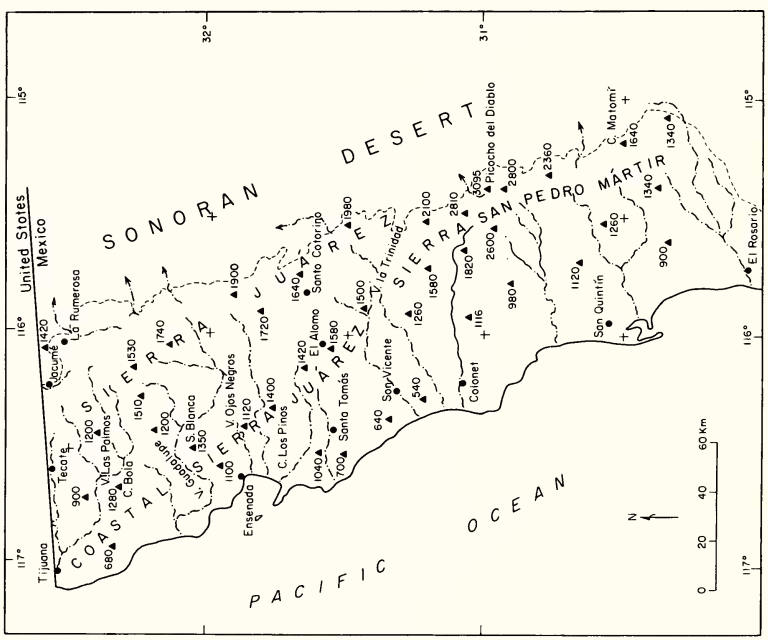

FIG. 1. Location map and place names of northern Baja California. Dashed line delimits Mediterranean vegetation (coastal sage scrub, chaparral, mixed conifer forest, pinyon forest) from the Sonoran Desert. ● = towns and villages. ▲ = mountain peaks.

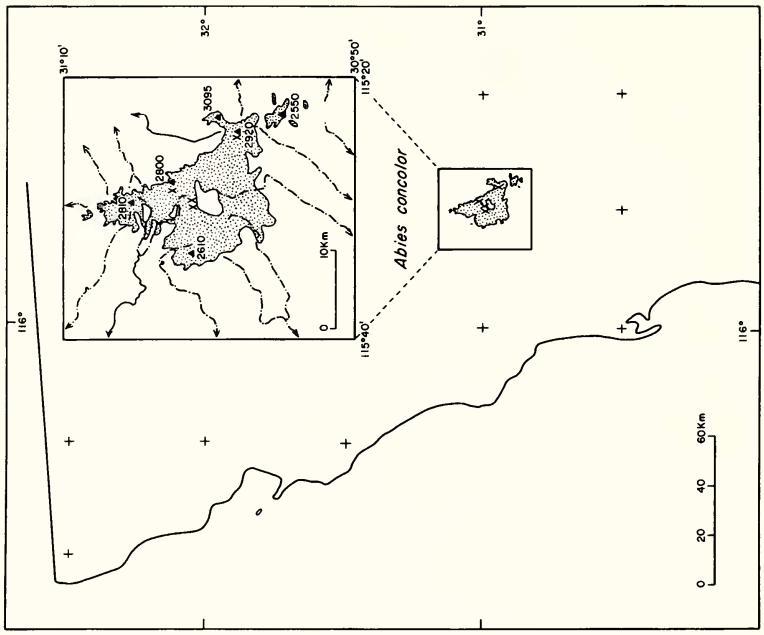

FIG. 2. The distribution of *Abies concolor*. Shaded areas mapped from aerial photographs. x = botanical collections.

discovered by Broder (1963) in the southern Sierra Juárez along Mesa Huicual, Mesa Valle Seco, and adjacent Cañada El Rincón southwest to near Santa Catarina (1200–1545 m). Trees along Cañada El Rincón are apparently old with large bole diameters (to 2 m), whereas stands on mesas are young due to chaparral fires (Moran 1972). A vaquero told Moran (pers. comm.) that the cypress also occurs in the next cañada south of El Rincón. In the 1986 aerial reconnaissance, I saw small colonies of this species to the southeast on an unnamed mesa south of Cañada El Rincón, on Mesa la Vinata Romero, in Cañón Alamito, and in Cañada la Esperanza. All stands grow on Miocene volcanics or Miocene postbatholithic continental sedimentary rocks (Gastil et al. 1975). Also, they occur in an area having a bimodal precipitation regime with limited winter rains, due to a rainshadow effect of the coastal Sierra Juárez, and with summer thundershowers. These conditions are similar to those of Arizona where *C. arizonica* occurs.

CUPRESSUS GUADALUPENSIS Wats. subsp. FORBESII (Jeps.) Beauchamp (Fig. 4). *Cupressus guadalupensis* subsp. *forbesii* occurs in San Diego County at Tecate Mountain, Otay Mountain, and near Guatay southwest of Cuyamaca Mountain (Griffin and Critchfield 1976). Botanical collections and aerial photographs show that these border populations are the northern limit of an extensive disjunct pattern of small groves. They are far more numerous than shown by Wolf (1948) and Little (1971) and occur for 150 km along coastal foothills of northern Baja California.

The northernmost stands in Mexico are extensions of U.S. populations at the border. Numerous colonies occur in near-coast foothills and mesas of the Cerro Bola range, especially at the south, between Cerro San Felipe and Cañada El Golpe. Interior outliers occur at Cerro Grande and 10 km south of Tecate. Another cluster of groves extends along the coast ranges north and east of Ensenada, from Rancho de la Cruz to Cerro Los Pinos, including Cerro Miracielo, Cañón los Cipreses, 1 km north of Cerro El Toro, and along the wash and adjacent northern exposures of Cañón San Carlos. To the south, isolated populations occur in coastal canyons with *Pinus muricata* west of San Vicente, above Rancho los Zaguaritos, an inland site at the summit of Cerro El Cipres (N), the upper headwaters of Cañón Nueva York, and at another Cerro El Cipres (S). Many groves are found at locations with "cipres" in place names on 1:50,000 scale topographic sheets.

Most stands grow in chaparral and are even-aged because of brushfires (see review by Vogl et al. 1977); scattered trees often occur in adjacent arroyos. The species grows between 200 and 1200 m, mostly on the Alistos or Rosario formations, although some inland and southern populations are on granodiorites. Nearly all stands grow on northern exposures, as in southern California (Vogl et al. 1977).

TABLE 4. PLACE NAMES[1] AND LOCATIONS. [1] = Place names from 1:50,000 topographic sheets. [2] = Specific locality of a collection or stand.

Place name	Latitude/longitude				Place name	Latitude/longitude			
	°N	′	°W	′		°N	′	°W	′
Agua Caliente de Guadalupe[2]	30	38	115	12	Cerro Picacho la Víbora	30	52	115	29
Arroyo Barbón	32	00	116	02	Cerro San Felipe	32	04	116	41
Arroyo de Agua Amarga[2]	30	23	115	15	Cerro San Luis[2]	29	19	114	17
Arroyo El Cajon Jumpoff	30	53	115	21	Cerro San Matías	31	14	115	31
Arroyo El Huico	31	07	115	33	Cerro Venado Blanco	31	05	115	30
Arroyo El Ranchito	32	02	116	08	Cerro 2040[2]	30	40	115	21
Arroyo El Socorro[2]	30	20	115	48	Cerro 2828	31	03	115	28
Arroyo El Tajo[2]	32	16	115	53	Corral De Sam	31	03	115	34
Arroyo El Tule[2]	31	54	115	58	El Alacrón[2]	31	52	115	56
Arroyo Hediondo[2]	31	15	116	20	El Alamo	31	35	116	05
Arroyo los Pinos	31	04	115	32	El Topo	32	15	115	59
Arroyo Palizada[2]	31	07	115	31	La Corona	30	58	115	35
Arroyo San Isidro[2]	31	17	116	18	La Encantada	30	55	115	25
Arroyo San Antonio	30	48	115	40	La Grulla	30	55	115	28
Arroyo San Simón[2]	30	38	115	20	La Matanza[2]	32	04	115	58
Arroyo Santa Eulalia[2]	30	38	115	17	La Rumerosa	32	30	116	03
Arroyo Santo Domingo[2]	30	46	115	54	La Tasajera	30	58	115	30
Caballo Muerto	31	50	115	57	La Víbora	30	52	115	30
Cañada Doña Petra[2]	31	56	116	36	Laguna Juárez (Hanson)	32	03	115	54
Cañada El Alamoso[2]	30	41	115	27	Los Encinos[2]	31	20	115	55
Cañada El Diablito[2]	31	04	115	21	Meling Ranch	30	59	115	44
Cañada El Golpe	32	07	116	40	Mesa Barreal	30	45	115	40
Cañada El Piquillo[2]	31	46	115	57	Mesa Huicual[2]	31	42	115	45
Cañada El Rincón	31	41	115	44	Mesa la Vinata Romero[2]	31	37	115	41
Cañada la Esperanza[2]	31	35	115	38	Mesa Valle Seco[2]	31	41	115	42
Cañón Agua Escondida	32	07	116	40	Mike's Sky Ranch	31	06	115	38

TABLE 4. CONTINUED.

Place name	Latitude/longitude °N	′	°W	′	Place name	Latitude/longitude °N	′	°W	′
Cañón Alamito[2]	31	36	115	38	Mount Augusta[2]	29	07	115	40
Cañón Arce[2]	31	58	116	36	Nejí	32	22	116	18
Cañón Borreguero	32	00	116	33	Oak Pasture	30	57	115	36
Cañón del Diablo	30	57	115	24	Observatory	31	02	115	28
Cañón Dolores	31	27	115	58	Picacho del Diablo	30	59	115	23
Cañón El Carmen[2]	31	57	116	46	Punta San Isidro[2]	31	20	116	25
Cañón El Carrizo[2]	31	13	115	50	Rancho de la Cruz	31	58	116	36
Cañón Huatamote	30	45	115	15	Rancho los Zaguaritos[2]	31	05	116	01
Cañón la Presa	32	25	116	52	Rancho San Faustino[2]	32	13	116	12
Cañón la Providencia	30	57	115	21	Rancho San Pedro Mártir	31	03	115	36
Cañón los Cipreses[2]	31	49	116	31	Río San Antonio[2]	30	48	115	39
Cañón Nueva York[2]	30	37	115	43	Río San Rafael	31	05	115	30
Cañón San Carlos	31	48	116	27	San Julio Canyon[2]	27	30	113	00
Cañón Santa Cruz[2]	31	26	116	23	San Pablo	31	30	115	57
Cerro Blanco[2]	31	58	116	31	San Vicente	31	19	116	15
Cerro Bola	32	22	116	43	Santa Catarina	31	40	115	50
Cerro Chato[2]	30	35	115	14	Santa Rosa Meadow	30	48	115	21
Cerro El Cipres (north)[2]	31	27	115	49	Sierra Blanca	32	03	116	29
Cerro El Cipres (south)[2]	30	23	115	38	Sierra San Borja[2]	28	49	113	34
Cerro El Topo[2]	32	13	116	01	Sierra San Luis[2]	29	19	114	17
Cerro El Toro	31	53	116	27	Tecate	32	28	116	35
Cerro Grande[2]	32	27	116	44	Uribes[2]	30	19	115	21
Cerro la Botella Azul	30	58	115	23	Valladares[2]	30	56	115	35
Cerro los Pinos	31	45	116	20	Vallecitos	31	00	115	30
Cerro Matomí[2]	30	22	115	07	Valle los Pinos	32	23	116	10
Cerro Miracielo	31	56	116	26	Valle Ojos Negros	31	50	116	15

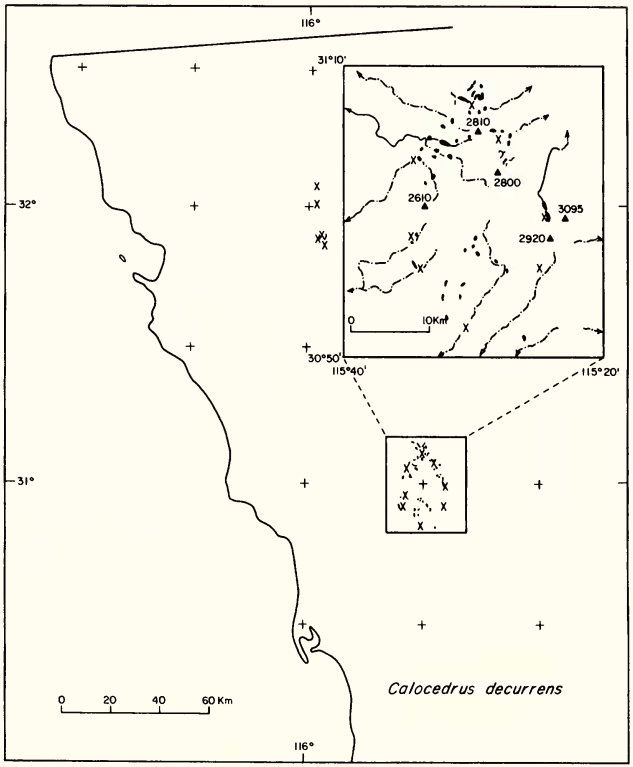

FIG. 3. The distribution of *Calocedrus decurrens*. Shaded areas mapped from aerial photographs. x = botanical collections.

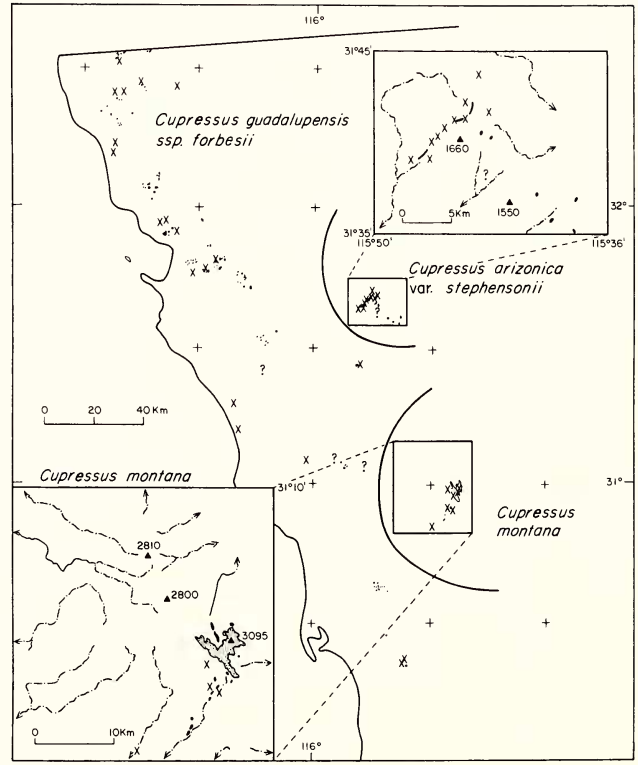

FIG. 4. The distributions of *Cupressus arizonica* var. *stephensonii, C. guadalupensis* subsp. *forbesii,* and *C. montana.* Shaded areas mapped from aerial photographs. x = botanical collections.

Cupressus guadalupensis also forms a significant forest on Guadalupe Island.

CUPRESSUS MONTANA Wigg. (Fig. 4). *Cupressus montana* is endemic to the Sierra San Pedro Mártir. Most stands are associated with a *Pinus lambertiana-Abies concolor* forest on steep granite walls along the eastern rim above 2200 m in the upper headwaters of Cañón del Diablo, Cañón la Providencia, and on the massive faces of Picacho del Diablo to near the summit (3095 m). Unlike many species of cypress, this tree develops great girth at the bole (1–2 m diam) and, thus, may be long-lived because forest productivity at these altitudes is diminished by cold climate. Juveniles may be seen down to 1400 m along Cañón del Diablo with *Quercus chrysolepis, Calocedrus decurrens,* and *Salix* spp. Scattered trees also are found along arroyos on the plateau, near Los Llanitos, above La Encantada, and on the main drainage between this meadow with La Grulla. Moran found one tree at La Víbora.

FRAXINUS VELUTINA Torr. var. CORIACEA (Wats.) Rehd. (Fig. 13). Arizona ash has been recorded in botanical collections in the southern Sierra San Pedro Mártir and adjacent coastal foothills, the Uribes, and along an unnamed arroyo near Cañada El Alamoso (800–1000 m). Wiggins collected the tree at Arroyo de Agua Amarga and at Agua Caliente de Guadalupe on the desert slope. *Fraxinus velutina* also occurs in San Julio Canyon in the Sierra San Francisco of central Baja California. The absence of records for Arizona ash in more mesic parts of the Sierra San Pedro Mártir and Sierra Juárez is peculiar. Several colonies in San Diego Co. at the international border (Griffin and Critchfield 1976) suggest that more intensive exploration will uncover other stands in northern Baja California.

PINUS ATTENUATA Lemmon (Fig. 5). Until recently, knobcone pine was collected only in the vicinity of Rancho de la Cruz, Cañón Arce, and Cañada Doña Petra (250–500 m) on the west flank of Cerro Miracielo (1100 m), north of Ensenada (cf. Map 58 in Critchfield and Little 1966). Aerial photographs from 1938 and 1956, however, show numerous stands along the north slope of this peak to near Cerro Blanco and Cañón Borreguero. Three groves were discovered by aerial reconnaissance 20 km southeast on a ridge at Cerro los Pinos. *Pinus attenuata* was recently collected in Cañón El Carmen, west of Valle Guadalupe. Occasional stands also may be present among numerous groves of *Cupressus guadalupensis* subsp. *forbesii* in the southern Cerro Bola range.

Similar to *C. guadalupensis* subsp. *forbesii, P. attenuata* grows in dense chaparral on the Alistos formation. Stands have an even-aged structure associated with canopy fires that are characteristic of the closed-cone pines (Vogl et al. 1977). Aerial photographs from 1972 show that most groves of *P. attenuata* on Cerro Miracielo were burned in a large fire in the late 1960's, but saplings were observed

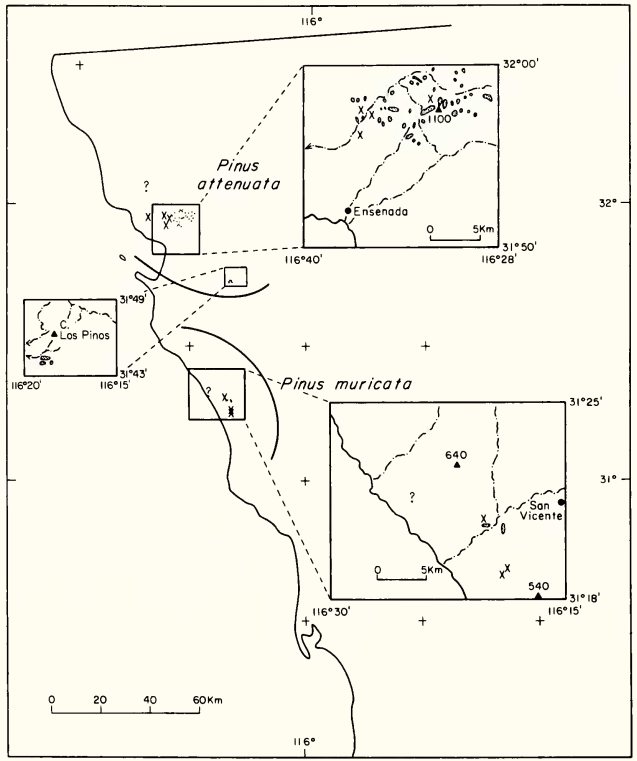

FIG. 5. The distributions of *Pinus attenuata* and *P. muricata*. Shaded areas mapped from aerial photographs. x = botanical collections.

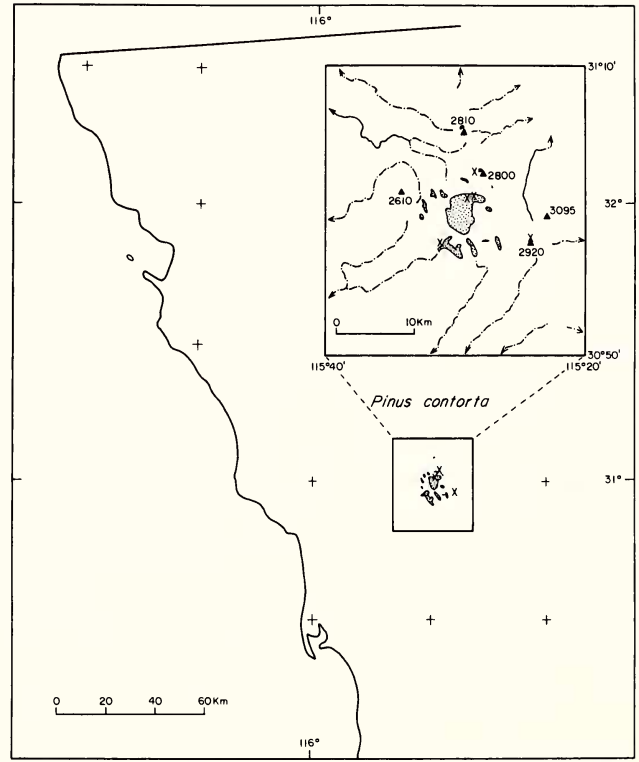

FIG. 6. The distribution of *Pinus contorta*. Shaded areas mapped from aerial photographs. x = botanical collections.

throughout the burn in the 1986 aerial reconnaissance. The nearest stand in California is 200 km to the north, on Pleasants Peak in the Santa Ana Mountains (Griffin and Critchfield 1976).

PINUS CONTORTA Dougl. ex Loud. (Fig. 6). Lodgepole pine is confined mostly to the Vallecitos and La Tasajera basins in the Sierra San Pedro Mártir (2300–2400 m), where it typically becomes the dominant tree at edges of meadows. Smaller colonies descend adjacent arroyos. This subalpine forest tree is absent from mixed conifer forests covering higher ridges east of Vallecitos (2700–2900 m) except for scattered trees on northern exposures near the summits of Cerro la Botella Azul, Cerro "2828" (observatory), and Cerro Venado Blanco. A few individuals were reported recently from Picacho del Diablo at 3095 m (M. Hamilton, pers. comm.).

Characteristically, *P. contorta* prefers to grow on poorly drained sites where potential competitors cannot grow (Fowells 1965). Strong nocturnal ground inversions with temperatures as low as −15°C in winter and 0°C in summer (Alvarez 1981) also may permit this subalpine species to grow in basin floors. Its absence from the highest peaks may be due to rainshadow effects that extend from the wetter western rim of the plateau, where scattered populations are found along watercourses down to 2200 m. The nearest forest of *P. contorta* in California is in the San Jacinto Mountains (270 km north).

PINUS COULTERI D. Don (Fig. 7). Coulter pine is rare in northern Baja California (Minnich 1986b). Most colonies grow in mixed chaparral, often with *Quercus chrysolepis,* on highly resistant bedrock in mesic parts of the interior sierra. The only stand (100 ha) in the coastal Sierra Juárez is on Sierra Blanca (1250 m), southeast of Valle Guadalupe (cf. Griffin and Critchfield 1976). In the interior Sierra Juárez, isolated colonies grow on granites that occur southwest of Rancho San Faustino (1500 m) and hillsides immediately west and northwest of Laguna Juárez (1800 m). Aerial photographs indicate a number of small colonies in similar habitats between these localities. To the south, Moran (1977) found small populations at 1600 m on the Miocene volcanic tablelands on the north and south rims of Cañada El Rincón. Large colonies on the western margin of Mesa Huicual are clearly evident on aerial photographs. Moran (1972) stated that the cones in these populations were unusually small for the species, but did not mention whether there was evidence of hybridization with *P. jeffreyi,* which grows within 2 km in Arroyo El Rincón.

Several groves of *P. coulteri* were found by aerial reconnaissance in the Sierra San Pedro Mártir. Stands as large as 100 ha occur on northern exposures of the main divide immediately north of the plateau; another is on the headwaters of Arroyo la Palizada. In the southern part of the range, several stands are on the northeast and northwest flanks of Cerro "2040". The San Pedro Mártir stands are

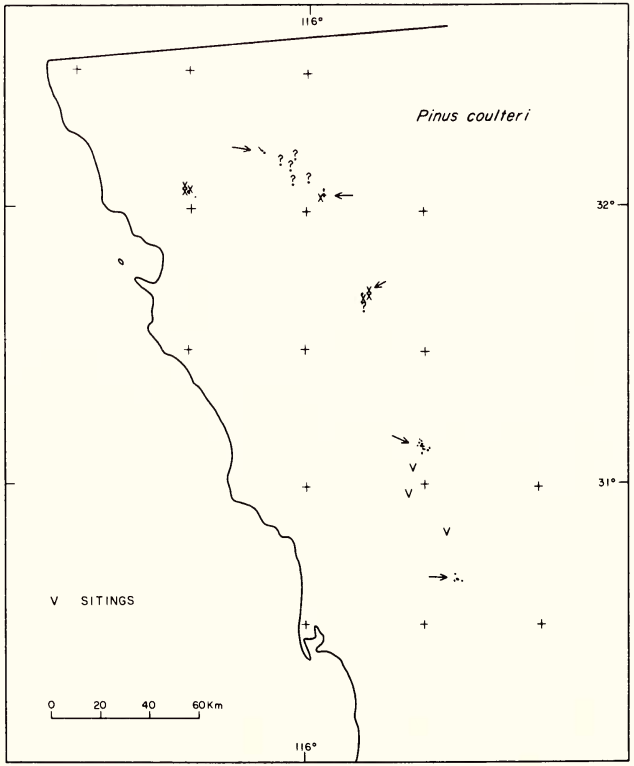

FIG. 7. The distribution of *Pinus coulteri*. Shaded areas mapped from aerial photographs. x = botanical collections. v = unverified sightings.

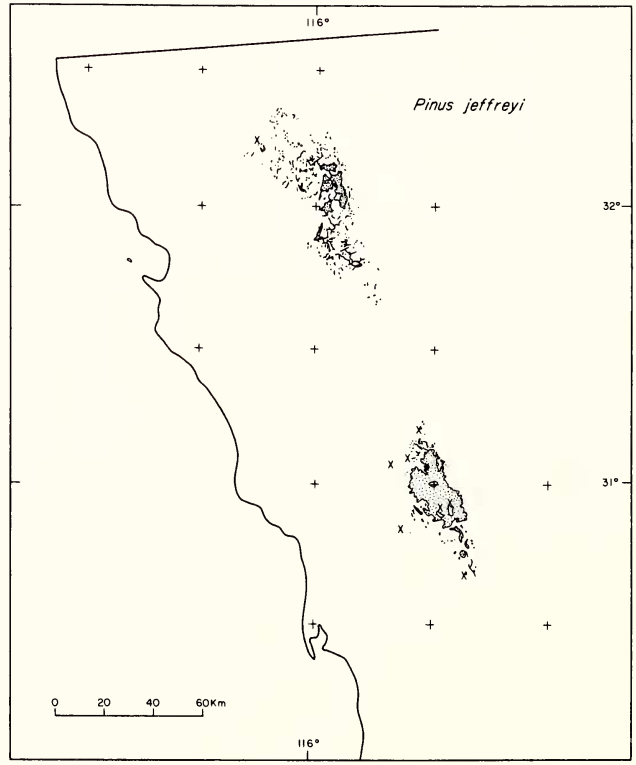

FIG. 8. The distribution of *Pinus jeffreyi*. Shaded areas mapped from aerial photographs. x = botanical collections.

all on northern exposures from 1900–2150 m. They also form even-aged stands that established after fires recorded on 1956 aerial photographs. According to Griffin and Critchfield (1976), three other *P. coulteri* localities occur in the range: northeast of Corral de Sam, upper La Corona Meadow (a single tree), and 8 km northwest of Santa Rosa Meadow. Although I have not seen any *P. coulteri* at these sites, Rojas-Gomez recently collected it at the northeast Corral de Sam site.

PINUS JEFFREYI Grev. & Balf. (Fig. 8). Jeffrey pine is the most important tree of mixed conifer forests along the crests of the Sierra Juárez and Sierra San Pedro Mártir (Minnich 1986b). Except for a few colonies of *C. decurrens* near watercourses, *P. jeffreyi* is the only tall tree in the Sierra Juárez, and forms extensive forests along meadows, basin floors, and watercourses above 1400 m from Valle Los Pinos to Arroyo El Rincón.

The northernmost stands in the Sierra San Pedro Mártir are five groves of ca. 50 trees on Cerro San Matías, an isolated peak (2100 m) 10 km north of the plateau. It recurs in several nearby basins (1600 m) in association with woodlands of *Quercus peninsularis* in the La Palizada, El Huico, and San Rafael drainages. On the Sierra San Pedro Mártir plateau above 2100 m, *P. jeffreyi* forms a zonal forest on slopes and basins above the chaparral belt in association with *Pinus lambertiana, Abies concolor, Quercus chrysolepis* and scattered understory of montane chaparral (*Arctostaphylos patula* Greene var. *platyphylla* Wells, *A. pungens* HBK., *A. pringlei* Parry, *A. peninsularis* Wells, *Ceanothus cordulatus* Kell., *Rhamnus californica* Esch., and *Quercus peninsularis*). It occurs up to 2900 m on the south face of Cerro Botella Azul. Scattered stands descend arroyos on the eastern scarp where it grows with *Calocedrus decurrens.* South of La Grulla and La Encantada meadows, *P. jeffreyi* again retreats to edges of meadows, basin floors, and arroyos down to ca. 1400 m. Moran found a few trees at 650 m near Río San Antonio on the west slope. The southernmost stands occur on Arroyos Fresnal and San Simón.

PINUS LAMBERTIANA Dougl. (Fig. 9). Sugar pine grows on the Vallecitos surface of the Sierra San Pedro Mártir, mostly on steep rocky slopes and cliffs in association with mixed conifer forest. It descends below elevations of *Abies concolor* (2100 m), with outposts extending further south beyond La Grulla and La Encantada meadows to Cerro Picacho la Víbora and scattered northern exposures near the Arroyo El Cajon jumpoff. A single tree at 1700 m was collected by Moran at Arroyo los Pinos near Rancho San Pedro Mártir. Sugar pine is locally dominant on the upper headwaters of the precipitous eastern rim and on Picacho Del Diablo up to 3000 m. The nearest stands in California are 200 km north, in the Cuyamaca Mountains of San Diego Co. (Griffin and Critchfield 1976).

PINUS MONOPHYLLA Torr. & Frém. (Fig. 10). Singleleaf pinyon grows almost exclusively along the arid eastern scarps of the Sierra Juárez and Sierra San Pedro Mártir. The geographic extent of *P. monophylla* was underestimated by Critchfield and Little (1966), who based their report on limited botanical collections.

In the Sierra Juárez, *P. monophylla* forms extensive forests above 1000 m in association with desert chaparral characteristic of the peninsular ranges (*Rhus ovata* Wats., *Quercus dunnii* Kell., *Q. cornelius-mulleri* Nixon and Steele, *Rhamnus crocea* Nutt., *Yucca schidigera* Roezl ex Ortges., *Y. whipplei* Torr., *Juniperus californica* Carr.). A few pinyons cross the border at Jacumé into southeastern San Diego Co. A major forest with *P. quadrifolia* occurs on a large plateau surface from La Rumorosa to El Topo, with *P. quadrifolia* dominant on the wetter western margin and *P. monophylla* dominant on the eastern rim. In the wetter central Sierra Juárez, *P. monophylla* forests decrease to a narrow belt along the eastern scarp. Scattered colonies occur on both Pacific and desert flanks of the arid southern Sierra Juárez tablelands and northern foothills of the Sierra San Pedro Mártir adjacent to Valle la Trinidad.

Extensive forests with desert chaparral understory dominated by *Arctostaphylos peninsularis* and *Quercus peninsularis* are found on the eastern flank of the Sierra San Pedro Mártir from 1200–2000 m, above which it is gradually replaced by *P. quadrifolia.* As the elevation of the range decreases south of 30°50′N, *P. monophylla* decreases to scattered outposts on high ridges within the east scarp. It was collected on the north slope of Cerro Matomí. The southern limit of the species is near Cerro San Luis in north central Baja California.

PINUS MURICATA D. Don (Fig. 5). In northern Baja California, this closed-cone pine is known only from the foggy coastal foothills southwest of San Vicente, including Arroyo San Isidro (see Map 59, Critchfield and Little 1966), Arroyo Hediondo, and near Punta San Isidro. All stands grow in chamise chaparral or succulent coastal sage scrub (Mooney 1977) in the upper Cretaceous Rosario formation. A few colonies grow with *Cupressus guadalupensis* subsp. *forbesii. Pinus muricata* stands reported on Cedros Island (Critchfield and Little 1966) were recently named *P. radiata* D. Don var. *cedrocensis* (Howell) Axelrod (Axelrod 1980).

PINUS QUADRIFOLIA Parl. ex Sudw. (Fig. 11). Four-needled pinyon is the most widespread coniferous tree in northern Baja California, but rarely occurs below 1200 m. Over most of its range, *P. quadrifolia* forms scattered groves within relatively dense chaparral of *Adenostoma fasciculatum* H. & A. and *A. sparsifolium* Torr. on the mesic western flank of the interior Sierra Juárez or continuous forests with desert chaparral along the crest and east rim. *Pinus quadrifolia* is often allopatric with *P. monophylla,* which is confined to the arid

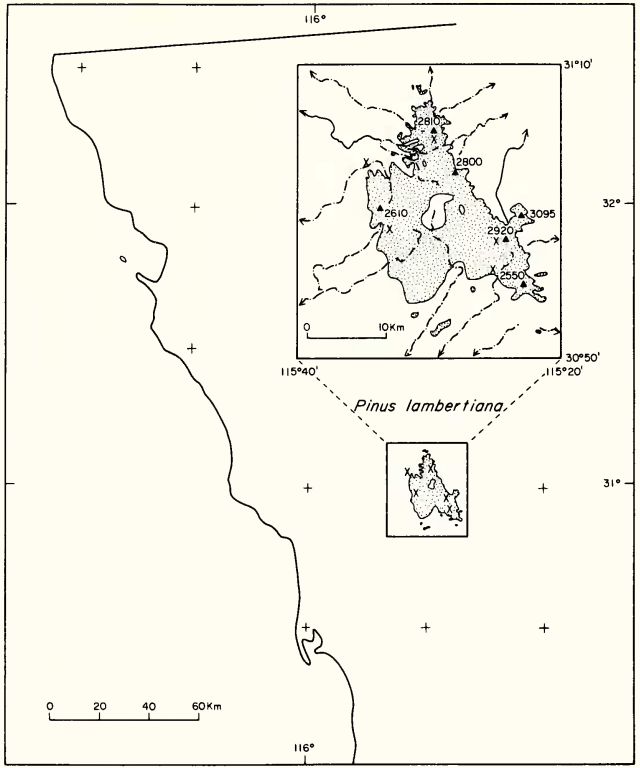

FIG. 9. The distribution of *Pinus lambertiana*. Shaded areas mapped from aerial photographs. x = botanical collections.

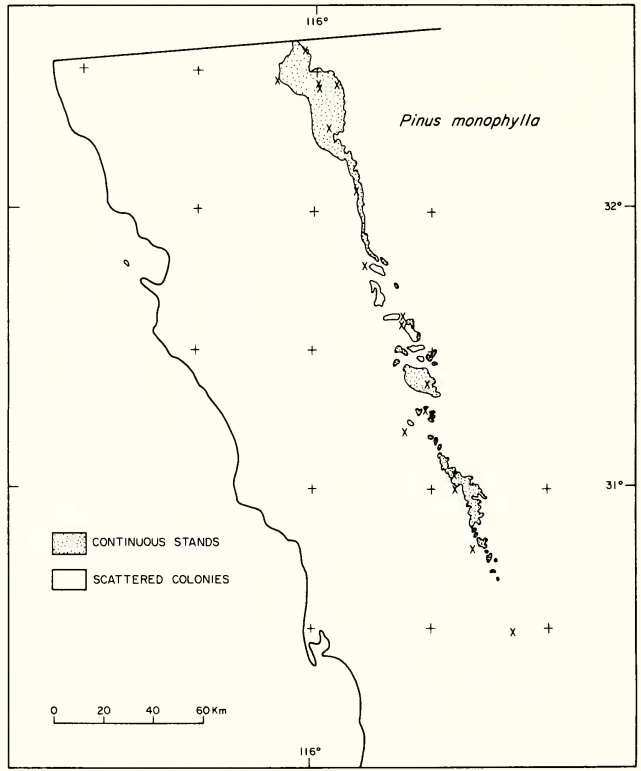

FIG. 10. The distribution of *Pinus monophylla*. Shaded and unshaded areas mapped from aerial photographs. x = botanical collections.

eastern scarps, similar to their distributions in the Peninsular Ranges of southern California (Map 16, Critchfield and Little 1966).

A few populations occur west of Jacumé near the international border. The most extensive forest overlaps with *P. monophylla* on the arid La Rumerosa-El Topo plateau, with smaller stands extending into shallow basins to the west. Numerous colonies pepper the chaparral belt on the Pacific slope of the wetter central Sierra Juárez, southward to Arroyo Barbón where the tree nearly drops out. The *P. quadrifolia* belt on desert drainages also narrows between the east margin of *P. jeffreyi* forests and *P. monophylla* forests on the eastern rim. *Pinus quadrifolia* then expands to form scattered cover on the Pacific and desert faces of the volcanic tablelands in the southern part of the range. Populations also extend westward along arid lee slopes on the coastal Sierra Juárez, including the Santa Catarina basin, El Alamo, and northwest to the southern edge of Valle Ojos Negros.

In the Sierra San Pedro Mártir, numerous groves of *P. quadrifolia* grow in mostly *Adenostoma* chaparral in higher basins north of the plateau. It then decreases to infrequent small colonies in dense chaparral on the mesic west flank of the range above the Meling Ranch. Stands become more frequent in the drier southern part of the range. Small outposts extend locally westward on higher spurs such as Mesa Barreal and major arroyos. On the eastern scarp, *P. quadrifolia* forms an extensive forest with *Arctostaphylos peninsularis, Quercus peninsularis,* and *Q. chrysolepis* understory from Cerro Venado Blanco to Arroyo El Cajon (1500–2500 m), where it meets Pacific slope groves. Although *P. quadrifolia* was collected up to 2700 m near the observatory, it is almost absent from the mixed conifer forest belt above 2100 m on the plateau. The southern limit is near Cerro Matomí.

Lanner (1974) provides evidence of extensive hybridization between *Pinus quadrifolia* and *P. monophylla* on the La Rumerosa-El Topo plateau. He suggests that *P. quadrifolia* should be replaced by *Pinus juarezensis* Lanner in this area.

PLATANUS RACEMOSA Nutt., POPULUS FREMONTII Wats. (Fig. 12). On aerial photographs, these riparian trees cannot be separated, but can be distinguished from other trees by their deciduous habit, canopy structure, and row-like stand arrangement along streams. Field reconnaissance indicates that most riparian forests consist primarily of *P. fremontii.*

The size of riparian forests is broadly proportional to streamflow. Stands are intermittent in the coastal Sierra Juárez where surface water is rarely permanent, except at Cañón Agua Escondida, and streams that cut through the ranges from the interior valleys. More continuous gallery forests follow the major arroyos descending the Pacific slope of the interior Sierra Juárez plateau below 1500 m,

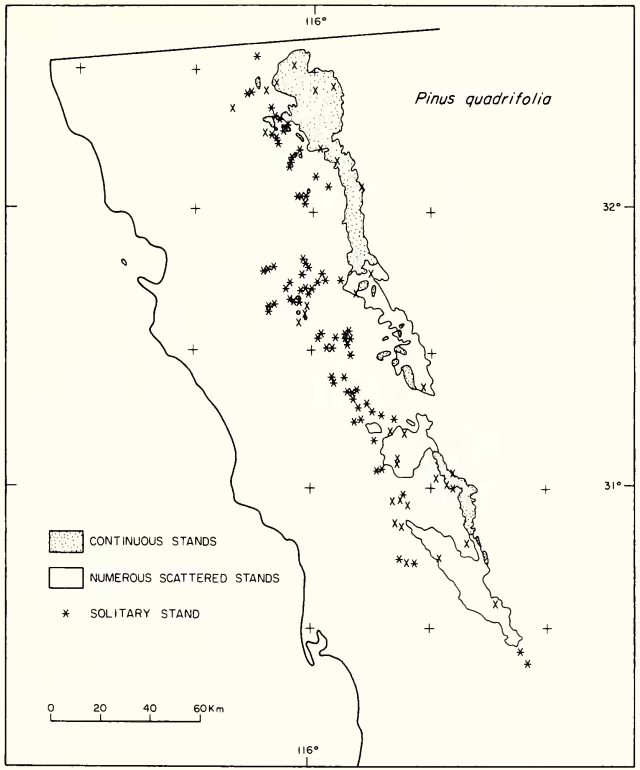

FIG. 11. The distribution of *Pinus quadrifolia*. Shaded and unshaded areas, and asterisks are mapped from aerial photographs. x = botanical collections.

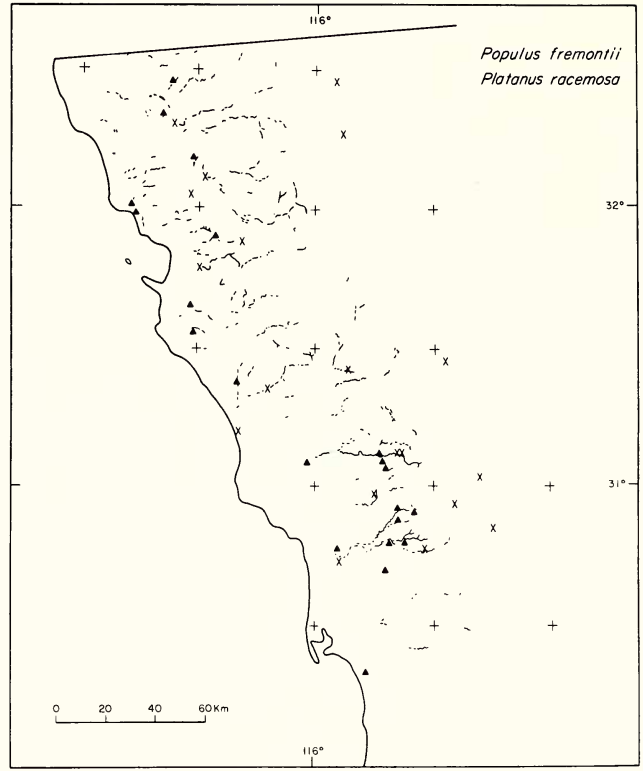

FIG. 12. The distributions of *Platanus racemosa* and *Populus fremontii*. Shaded areas are both species mapped together from aerial photographs. x = botanical collections of *P. fremontii*. △ = botanical collections of *Platanus racemosa*.

except in the arid southern tablelands. The largest forests follow Arroyo Santo Domingo and Río San Rafael that drain the high Sierra San Pedro Mártir.

Botanical collections show that *P. fremontii,* the only tree to span the Baja California peninsula (Wiggins 1980), is occasional in desert canyons of both the Sierra Juárez and Sierra San Pedro Mártir, including Arroyo El Cajón, Cañada El Diablito, and Arroyo El Tajo. *Platanus racemosa* occurs mostly below 1000 m on the Pacific slope of the Sierra Juárez and western foothills of the Sierra San Pedro Mártir, and south to Arroyo El Socorro.

POPULUS TREMULOIDES Michx. (Fig. 13). Numerous groves of quaking aspen occur in the Sierra San Pedro Mártir above 2300 m along watercourses, on edges of meadows, and near springs. Most trees are small (<10 m), but some reach 25 m at permanent wet sites. Only the largest groves could be mapped and are recognized by their deciduous habit and compact grove structure on aerial photographs. These include stands near Cerro Venado Blanco, along the east ridge from the observatory to east of La Encantada Meadow, and margins of Vallecitos Meadow. On the eastern scarp, groves occur on the headwalls just northeast of the observatory and the upper north face of Picacho del Diablo. The nearest stands north of Baja California are two groves at Fish Creek and Gocke Valley, 350 km north in the eastern San Bernardino Mountains (Griffin and Critchfield 1976).

POPULUS TRICHOCARPA T. & G. (Fig. 13). Black cottonwood occurs at only two localities in the Sierra San Pedro Mártir: along Arroyo la Grulla (1400 m), 4 km southwest of La Grulla Meadow, and along Rio San Rafael (1325 m).

QUERCUS AGRIFOLIA Neé (Fig. 14). Coast live oak, the most widespread hardwood tree in northern Baja California, grows mostly near stream banks, on meadow perimeters, and on basin floors within the chaparral belt. It occasionally grows on north exposures, especially near the international border.

Widespread stands in adjacent San Diego Co. (Griffin and Critchfield 1976) continue south along the mesic coastal flank of the interior Sierra Juárez below 1300 m. *Quercus agrifolia* is particularly abundant between Tecate and Nejí. Stand frequency decreases southward along the range except for large gallery forests along arroyos Barbón and El Ranchito. It drops out at Cañada El Piquillo, avoiding the arid southern Sierra Juárez tablelands. *Quercus agrifolia* is occasional in arid interior valleys north of Valle Ojos Negros.

In the coastal Sierra Juárez, *Q. agrifolia* is abundant in all the subranges from Cañón La Presa to Ensenada Bay and Valle Santo Tomás and continues southward along the near-coast foothills to Cañón Santa Cruz. At Valle Santo Tomás, scattered populations swing inland along the arroyos of the transverse coastal ranges par-

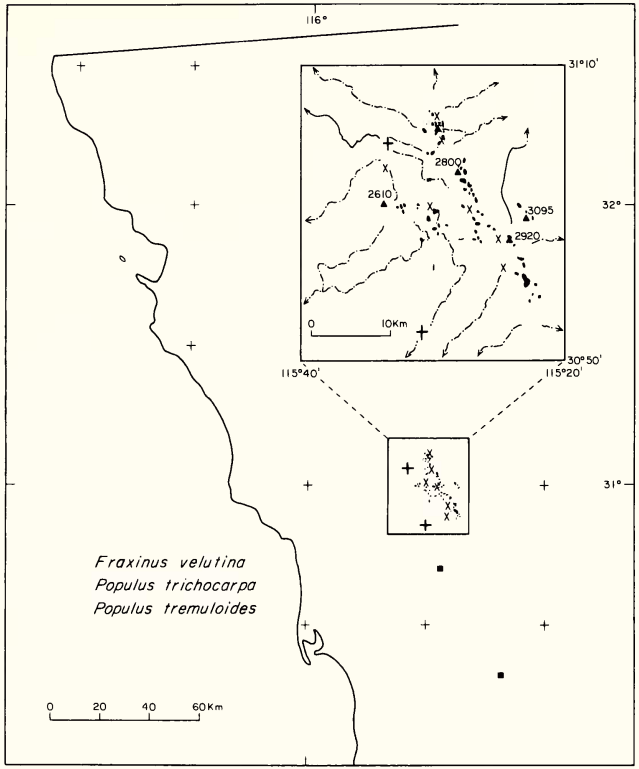

FIG. 13. The distributions of *Fraxinus velutina, Populus tremuloides,* and *P. trichocarpa.* Shaded areas are *P. tremuloides* mapped from aerial photographs. Botanical collections: x = *P. tremuloides,* + = *P. trichocarpa,* ■ = *F. velutina* var. *coriacea.*

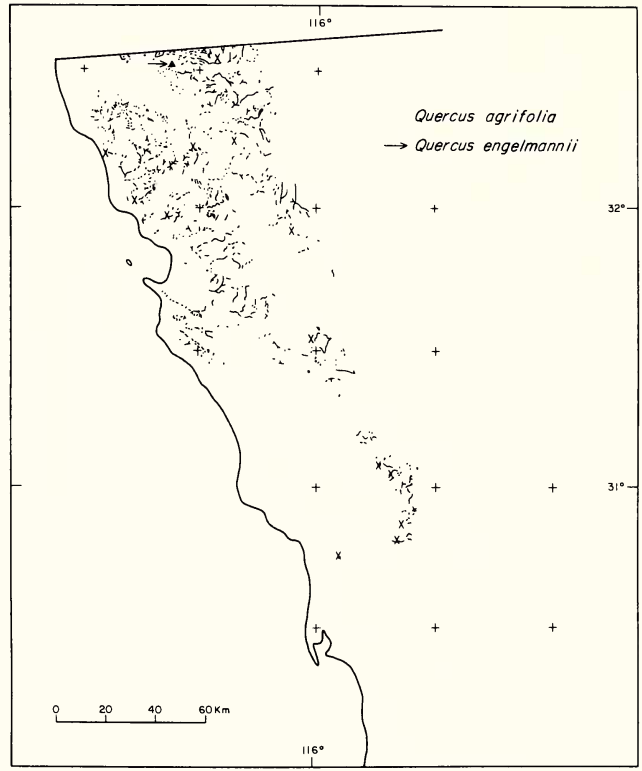

FIG. 14. The distributions of *Quercus agrifolia* and *Q. engelmannii.* Shaded areas are *Q. agrifolia* mapped from aerial photographs. Botanical collections: x = *Q. agrifolia,* △ = *Q. engelmannii.*

alleling the Agua Blanca fault to the east end of Cañón Dolores (cf. Orcutt 1887).

A single grove of *Q. agrifolia* at Los Encinos is the only population within a 25 km span between coastal Sierra Juárez forests and those at Cañón El Carrizo at the northwest end of the Sierra San Pedro Mártir. It is common along the major arroyos on the mesic western face of the high Sierra San Pedro Mártir from 1200–1700 m. The southernmost locality is a single grove on a stream bank near the coast along Arroyo Santo Domingo.

QUERCUS CHRYSOLEPIS Leibm. (Fig. 15). Most stands of *Quercus chrysolepis* consist of small-leaved shrubs to small trees (<8 m) (Myatt 1975) that grow on steep, well-drained slopes and canyons in the higher sierra above 1500 m. In the interior Sierra Juárez, *Q. chrysolepis* occurs mostly in chaparral on the highest peaks of the plateau. The largest stands concentrate around Rancho San Faustino, northwest of Laguna Juárez, near Caballo Muerto, and northern exposures of mesas and peaks in the southern tablelands. It is found at lower altitudes (1000–1400 m) on northern exposures of several peaks in the coastal Sierra Juárez (e.g., Cerro Bola, Sierra Blanca, and Cerro los Pinos).

In the Sierra San Pedro Mártir, outposts occur on Cerro San Matías (2100 m) and adjacent peaks at the north end of the range. A small grove of *Q. chrysolepis* is found on the north slope of Cerro Blanco (1900 m) near Mike's Sky Ranch. It is widespread in the highest part of the range above 1900 m, mostly as understory to *P. quadrifolia* forests on the east scarp and mixed conifer forests on the plateau, with scattered stands locally entering canyons and northern exposures at the upper margin of the chaparral belt on the west slope. It grows as a large tree (ca. 15 m) near streams along the headwaters of Arroyo la Palizada, and most deep canyons within the eastern scarp north of Picacho del Diablo that includes upper Cañón la Providencia. *Quercus chrysolepis* is absent from cold Vallecitos basin, and highest peaks above 2300–2700 m. South of La Grulla and La Encantada meadows, *Q. chrysolepis* is restricted to northern exposures of highest peaks. The southern limit is Cerro Chato.

QUERCUS ENGELMANNII Greene (Fig. 14). Although numerous populations of *Q. engelmannii* have been recorded near the international border in San Diego Co. (Griffin and Critchfield 1976), only a few trees have been found in northern Baja California (4 km south of Tecate). Although the partly winter-deciduous habit helps differentiate this tree from *Q. agrifolia,* aerial photographs in winter do not show recognizable populations elsewhere in Baja California. Scattered trees undoubtedly will be discovered at new localities, perhaps in the vicinity of Tecate and the Cerro Bola range.

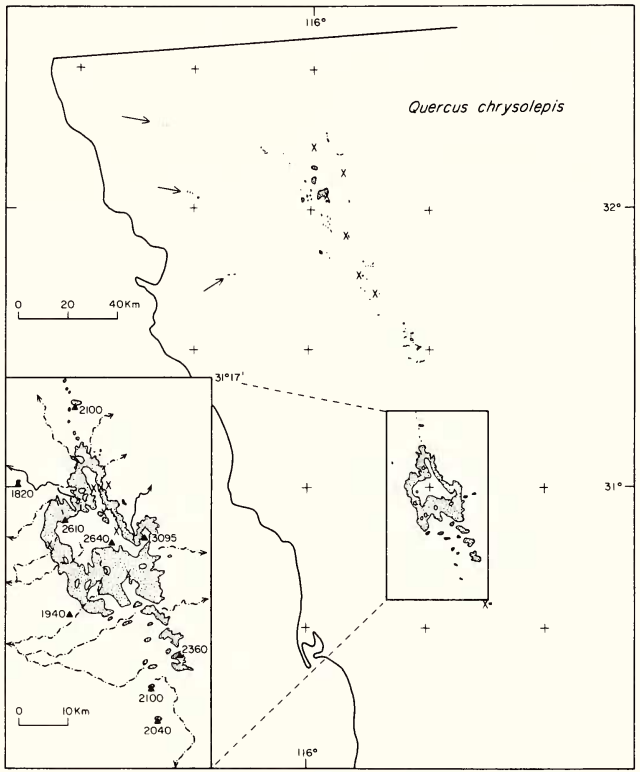

FIG. 15. The distribution of *Quercus chrysolepis*. Shaded areas mapped from aerial photographs. x = botanical collections.

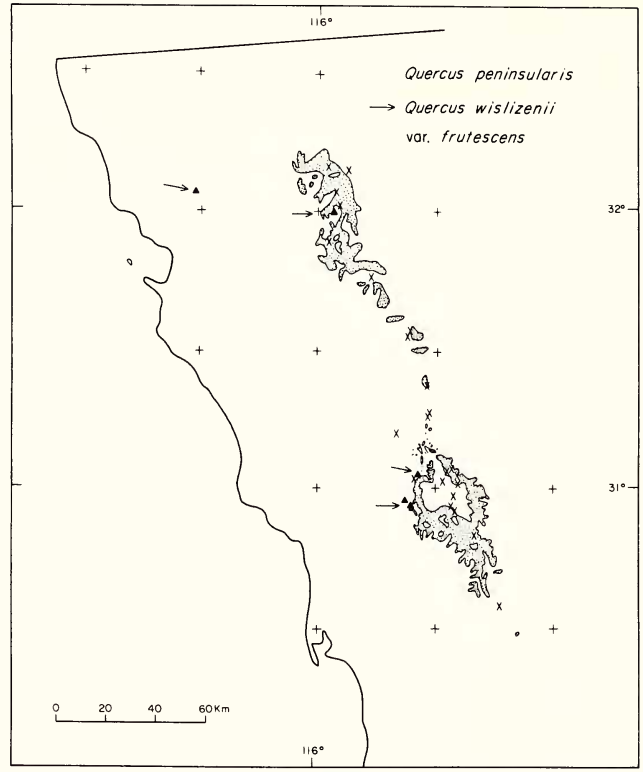

FIG. 16. The distributions of *Quercus peninsularis* and *Q. wislizenii*. Shaded areas are *Q. peninsularis* mapped from aerial photographs. Botanical collections: x = *Q. peninsularis*, △ = *Q. wislizenii* var. *frutescens*.

QUERCUS PENINSULARIS Trel. (Fig. 16). An endemic to inland ranges of Baja California, *Q. peninsularis* is closely related to *Q. emoryi* (Muller 1965), widespread in northern Mexico, Arizona, and New Mexico. In the interior Sierra Juárez, *Q. peninsularis* is mostly a shrub to small tree in association with *P. jeffreyi* forests. The northernmost stand is near Cerro El Topo. It is occasional with pinyon forests along the east rim and the arid volcanic tablelands to the south. Botanical collections show that locally it descends arroyos on the Pacific slope down to 1200 m, avoiding the chaparral.

Quercus peninsularis is infrequent throughout the mixed conifer forest belt of the Sierra San Pedro Mártir; it is particularly abundant with *P. jeffreyi* forest at the south end of the range, where it occasionally grows into a robust tree 15 m in height and spread at wet sites. It is absent from the chaparral belt on the Pacific slope except along arroyos or forest margins. On the desert scarp, it is a zonal component of desert chaparral understory of *P. monophylla* and *P. quadrifolia* forests from 1000–2500 m from Cañada la Esperanza to Cañón Huatamote. Its abundance perhaps reflects summer rain on the eastern scarp, as in the area of *Q. emoryi* in mainland Mexico. The southernmost collection of *Q. peninsularis* in the Sierra San Pedro Mártir is from Cerro Chato. The tree occurs on the summits of Sierra San Luis, and Sierra San Borja, its southern limit.

QUERCUS WISLIZENII A. DC. var. FRUTESCENS Engelm. (Fig. 16). Field reconnaissances and botanical collections show that interior live oak is rare in northern Baja California and was not listed by Wiggins (1980). All known stands, usually a few individuals, occur at the conifer forest–chaparral ecotone (1200–1700 m) in the wettest parts of the Sierra. In the Sierra Juárez, it was seen or collected on Sierra Blanca and above Laguna Juárez. In the Sierra San Pedro Mártir, it was found on a steep northern exposure near Arroyo Los Pinos, at Arroyo La Corona, southeast of Oak Pasture, and in *Q. agrifolia* woodland below the Parque Naciónal entrance. *Quercus wislizenii* is unusually large (to 10 m) at the latter site, confirming Brandegee's (1893) observation that it formed large bushes in the Sierra San Pedro Mártir. Further botanical collecting should expand the known range of this tree in northern Baja California.

OTHER SPECIES

Three tree species known primarily from California occur south of the border only in central Baja California. *Quercus tomentella* Engelm. occurs in an arroyo 3 km east of Mt. Augusta along the coast and on Guadalupe Island (Wiggins 1980); *Prunus lyonii* (Eastw.) Sarg. is found in the Sierra San Francisco northwest of San Ignacio. It appears that both trees survive at these localities in part through isolation from *Quercus chrysolepis* and *Prunus ilicifolia* (Nutt.) Walp.,

with which they freely hybridize (Muller 1965; Everett 1957). *Pinus radiata* D. Don grows in the summer stratus fog-drip zone of Cedros and Guadalupe Islands (700–900 m) (Critchfield and Little 1966).

Near Misses

Several California trees have southern limits in the Cuyamaca Mountains within 50 km of the international border, including *Acer macrophyllum* Pursh, *A. negundo* L. subsp. *californicum* (T. & G.) Wesmael, *Alnus rhombifolia* Nutt., *Cornus nuttallii* Aud., *Pinus ponderosa* Dougl. ex P. & C. Lawson, *Quercus kelloggii* Newb., and *Umbellularia californica* (H. & A.) Nutt. (Griffin and Critchfield 1976). Although the biogeography of organisms seems to be influenced by the intensity of collecting and field surveys, the rapid decrease in forest diversity at the border may be no coincidence because of the strong precipitation gradients associated with relief. The Cuyamaca Mountains have a steep western face and no upwind rainshadows toward the Pacific Ocean. Precipitation from winter cyclonic storms concentrates along a narrow zone at the crest of the range, where annual amounts approach 1000 mm (California 1980). In the Sierra Juárez, orographic lift of rain-bearing air masses is spread over a wider area along gentle west-facing slopes. Rainshadows extend over the range from the coastal Sierra Juárez. Favorable orography on the steep west face of the Sierra San Pedro Mártir is compensated by decreased winter storm activity southward. Thus, few areas in northern Baja California have more than 500 mm annual precipitation, or half the amount in the Cuyamaca Mountains. In southern California, nearly all trees with southern limits in San Diego Co. grow in mesic habitats compared to trees with ranges extending into Baja California.

Several California trees have been erroneously reported in Baja California as a result of the misidentification of specimens and misinterpretation of common plant names and place names. Reports of *Pinus edulis* Engelm. in the Sierra Juárez and *P. cembroides* Zucc. in the southern Sierra San Pedro Mártir (Wiggins 1980) appear to be based on collections of *P. quadrifolia*. According to Moran, claims by rangers that *P. ponderosa* also occurs in the central Sierra Juárez are based on invalid taxonomic criteria (see also Duffield and Cumming, 1949; Wiggins, 1980). The only evidence for *Umbellularia californica* (cf. Wiggins 1980) appears to be a ranch named Tres Laureles, 5 km south of Tecate. References to *Pseudotsuga macrocarpa* (Vasey) Mayr in northern Baja California may have resulted from descriptions of "spruce" in the Sierra San Pedro Mártir or from confusion of a valley named San Felipe in Baja California with one in San Diego County (Minnich 1982). The reports of *Arbutus menziesii* Pursh (Wiggins 1980) are doubtful. Perhaps they are based on

18th century diaries by Arrillaga (Tiscareno 1969) and Longinos-Martínez (Simpson 1938) who use the name madroño in areas where *Arctostaphylos* spp. now occur, including hillsides above La Encantada (Longinos-Martínez), near San Pablo, west of Santa Catarina, ca. 5 km north of Valle La Trinidad, La Encantada, southern Valle San Rafael and several locations on the Sierra Juárez plateau (Arrillaga). Spanish diarists also may have confused the more rare *Heteromeles arbutifolia* with the Mediterranean *Arbutus unedo,* which is still called madroño in Spain. Likewise, references to "alder" (*Alnus rhombifolia*) by these diarists, as well as Serra (Tibesar 1955) and Crespi (Bolton 1927), appears to be a mistranslation for *Platanus racemosa,* which also was called "aliso". Thus, 18th century diarists probably saw sycamores when they traveled through northern Baja California.

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